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(56) Documents Cited by ISA
US 5584701 A US 5509810 A US 4828501 A

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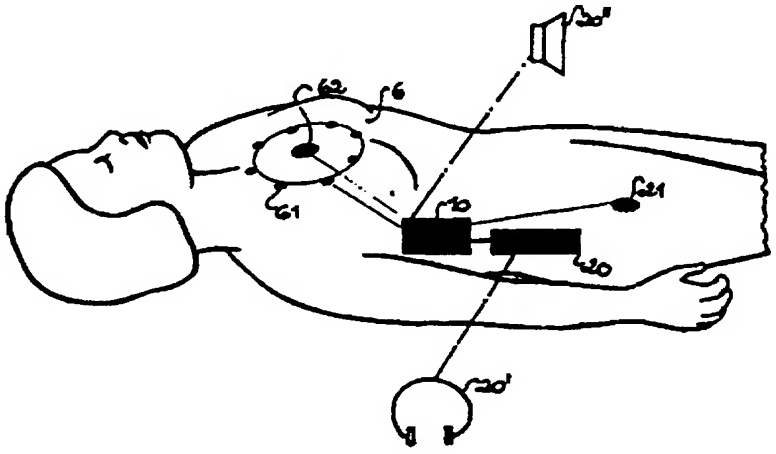
(54) Abstract Title
Cardiopulmonary resuscitation (CPR) training model of the human body

(57) The invention relates to a cardiopulmonary resuscitation (CPR) training model of the human body, with an imitation of the thoracic cage (6) and the head (1), comprising sensors (12, 21, 22, 31, 42, 48, 51) and a device (10) controlled by the sensor signals designed to generate voice error or correction messages, whereby the device controlled by the sensor signals is located inside the model. The signal controlled device is embodied is such a way that it can utter the sounds expected from a patient during CPR in addition to producing error and/or correction messages.



GB 2 339 323 A

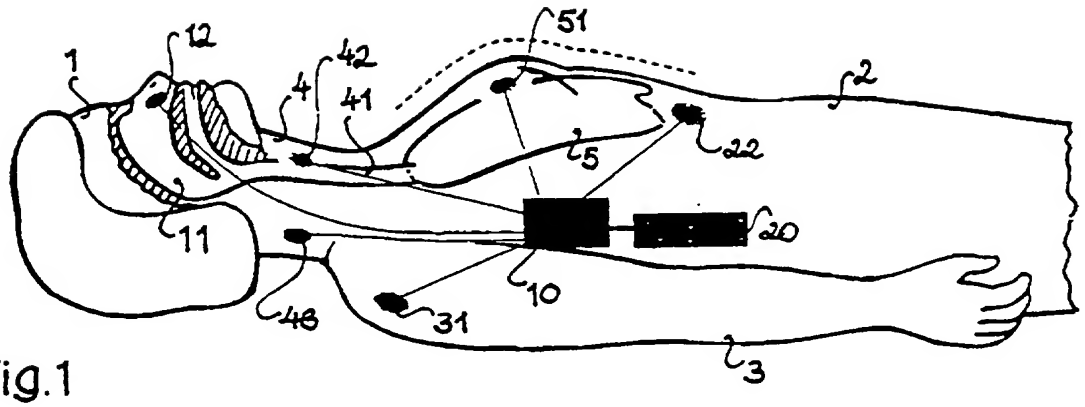


Fig.1

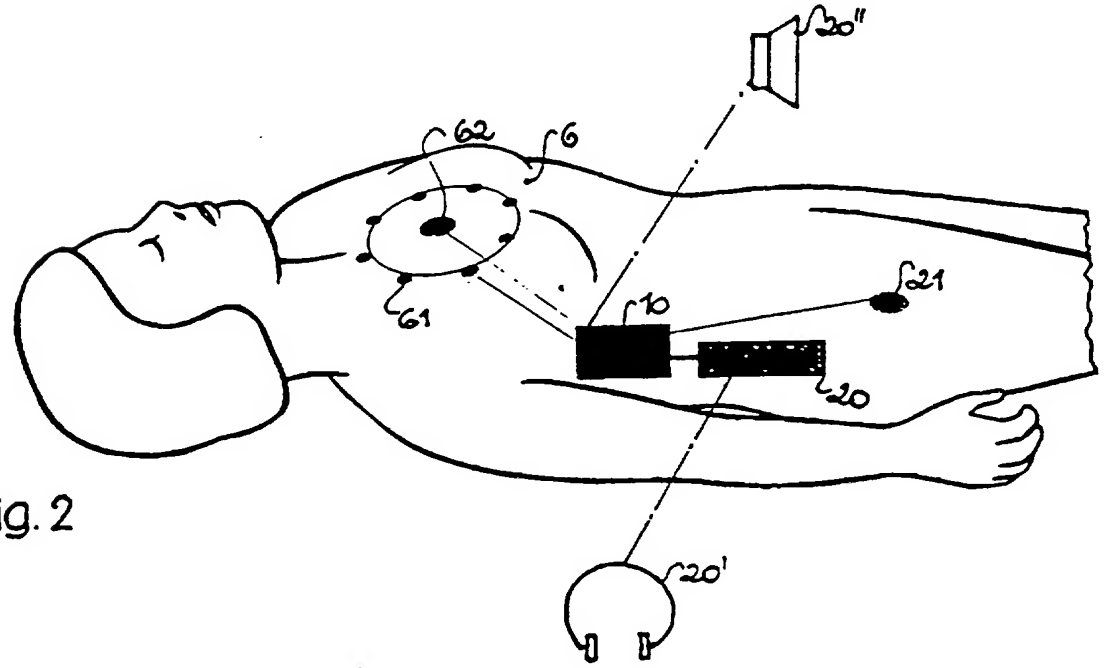


Fig. 2

Dummy for practising cardiopulmonary resuscitation (CPR) of a human being

Description

The invention relates to a dummy for practising cardiopulmonary resuscitation (CPR) of a human being, having the features set forth in the classifying portion of claim 1.

Satisfactory mastery of CPR presupposes frequent practice. For that purpose, many different forms of dummies are known, which substantially accurately simulate the human upper body including the head and which include a lungs simulation which can be the subject of artificial respiration through a mouth and/or nose opening. Furthermore the thorax simulation is of such a configuration and nature that the dummy behaves in a true-to-life fashion both in regard to heart massage and also in regard to artificial respiration. It has been found that success in learning when practising CPR is at its greatest when the corresponding dummy admittedly comes close to a human body in particular in terms of the reactions to be expected to the CPR to be implemented, but also in terms of appearance. For, that causes the person practising the routine to remember most clearly correct implementation of the CPR procedure as soon as he is confronted with the task of actually applying the CPR that he has learnt through practice.

In order also to learn by practice in one go and in as true-to-life fashion as possible the individual handling operations which are to be carried into effect in performing CPR, practice dummies of the kind set forth hereinbefore are also known, which, by way of incorporated sensors, detect the individual handling operations, for example thorax compression upon heart massage and artificial respiration, in terms of the correctness

thereof, and cause a suitable piece of equipment to output error and/or correction messages, in the event of the handling operations being defective (US No 43 60 345, DE 36 38 192 A1). The apparatus which is controlled by the signals from the sensors can have a display screen which for example shows correct positioning of the hands when effecting thorax compression, wherein that representation is accompanied by spoken instructions over a loudspeaker. A disadvantage of that mode of representation however is that it diverts the person practising the procedure or trainee away from concentrating on his actual activity if he has to turn his view from the dummy to the display screen. Another known apparatus is therefore limited in regard to representation of correct handling or the extent of the intensity with which the handling operations are to be implemented, to a graphic reproduction by means of an LCD-display which can be set up in the immediate proximity of the dummy so that it is in the field of view of the trainee. Speech instructions however are not included in this case.

The object of the present invention is so to design a dummy of the kind set forth in the opening part of this specification that the person practising CPR thereon receives the error and/or correction instructions supplied by the sensors in a manner which diverts him to a lesser degree from carrying out the practice procedure and which in addition provides him with information which even more closely approximates the dummy to actual aspects.

In accordance with the invention that object is attained by the configuration set forth in claim 1.

As in accordance with the invention the apparatus which is signal-controlled by the sensors is disposed in the simulation, that is to say in the dummy itself the speech error and/or correction messages generated act almost authentically as sounds or utterances from the dummy itself. As part of the practice involved in training with CPR involves concentrating on the behaviour of the patient to be handled, an instruction originating from the dummy itself does not go outside the range of attentiveness of the

person practising the CPR procedure. It has been found that in that way the person practising the procedure has to divide his attention less between the training procedure to be carried out and the instruction with which he is supplied, even if it is clear that such a behaviour is not to be expected when dealing with an actual patient.

In accordance with a further preferred embodiment of the invention however the dummy behaves in a particularly realistic fashion by virtue of the fact that the signal-controlled apparatus produces noise utterances of a patient simulated by the dummy, which utterances are to be expected when dealing with actual patients. That applies in particular if such noise utterances allow a conclusion to be drawn about the state of the patient or even, if they occur when defective CPR-actions are implemented, the nature of the error involved. Noise utterances are of different kinds and may be a grunt, a cough or a groan. In addition a belch and choking and vomiting can also be produced, which do not have to be exclusively the consequence of defective CPR handling operations, but which can also occur when simply moving the body of the patient, for example just when moving an arm or the head into the correct position. Attempts at speech on the part of patients are also entirely realistic. Added to that are noise utterances which the patient does not produce by way of the trachea and/or the mouth, but which occur in the interior of the body due to displacements of air or gas upon thorax compression and/or when implementing artificial respiration. The occurrence of all those noise utterances, particularly when a realistic association with the nature of the CPR procedure being carried out is involved, can already afford the person practising the procedure a kind of experience which frequently can only be obtained in real cases after actually carrying out CPR.

The signal-controlled apparatus desirably includes a computer unit (CPU) or a microprocessor which processes signals transmitted from sensors and passes them to a loudspeaker for output of the speech instructions or the noise utterances. In that respect a matter of significance is that the person practising the CPR procedure has the impression that the

instructions and in particular the noise utterances come from the dummy itself. Therefore either the loudspeaker is disposed in the dummy itself or the CPU or microprocessor communicates with a headset which is worn by the person practising on the dummy. Desirably the apparatus is connected in such a way that both a loudspeaker disposed in the interior of the dummy and also a headset can be used, in which case when the headset is in use the loudspeaker in the interior of the dummy is inoperative. That is found to be an advantage when, on courses with a large number of participants, each participant on the course is practising on a dummy. For, in that case, when each participant uses a headset, that avoids the concentration of each participant on his practise being disturbed by instructions and/or noise utterances which come from the dummies of the adjacent participants.

In accordance with a further embodiment of the invention it is also envisaged that the signal-controlled apparatus is of such a configuration that it passes error and/or correction messages in the form of speech instructions on the one hand and noise utterances of a patient on the other hand to separate loudspeakers. In that case the loudspeaker which reproduces the speech instructions may even be connected to a loudspeaker which is disposed outside the dummy and which is a loudspeaker provided for the instructions alone or can be switched over to the loudspeaker which is specifically disposed in the interior of the dummy. In that way it is possible to take account of people who feel themselves irritated by speech instructions which come from the dummy and which naturally cannot be uttered by a real patient to be resuscitated. In this case, the noise utterances of the patient are produced by a loudspeaker disposed in the interior of the dummy and/or a headset while the speech instructions come only from the external loudspeaker.

Matching of the noise utterances or instructions which are to be supplied by the signal-controlled apparatus to each other, adaptation thereof to each other and the sequence thereof also substantially corresponds, besides the conditions which occur in a real situation, to pedagogical points of view, consideration of which results in an optimum

impression being made on the part of the person practising CPR. A selection of such points of view is to be found in the description hereinafter of an embodiment given by way of example with reference to the accompanying drawings and appendant claims. In the drawings:

Figure 1 is a purely diagrammatic perspective view of a dummy in which the position of sensors disposed in the interior of the dummy is shown, and

Figure 2 is a view similar to Figure 1 showing the position of sensors disposed substantially at or in the proximity of the outside of the torso.

The dummy according to the invention as shown in Figures 1 and 2 comprises a head simulation 1 and a torso 2 with arms 3. The torso 2 can be extended into legs and feet (not shown). The head simulation 1 is connected to the torso 2 by way of a neck simulation 4 in such a way that it is movable at least in the forward and rearward direction in order thereby to be able to simulate the rearwardly tilted head posture required for regular CPR. Indicated in the interior of the head simulation in partial section is a mouth and nose opening 11 which is communicated with a lungs simulation 5 by way of a trachea simulation 41. The lungs simulation 5 is an inflatable plastic bag which lies flat. Disposed in the interior of the torso 2 under the lungs simulation 5 is a spring mechanism (not shown) with a pressure plate which imparts to the thorax simulation 6 of the torso a capacity for resistance in relation to compression forces applied from above, such capacity for resistance corresponding to that of a human thorax.

The pivoting mechanism in the neck simulation 4, by which the head simulation 1 is connected to the thorax simulation 6, the arrangement of the lungs simulation 5 and the communication thereof with the oral/nasal cavity 11 and the spring mechanism (not shown) in the thorax simulation 6, by which the compression behaviour of the human thorax is simulated, are known in many different configurations in the state of the art and therefore do not need to be described in greater detail at this point.

Just by way of example attention may be directed to the structures disclosed in DE 36 38 192 A1, DE 42 01 768 A1 and PCT/DE 98/00095 to which reference is hereby made.

Disposed in the dummy according to the invention is a series of sensors which are associated with the individual body and organ simulations. Incorporated in the head simulation 1 is a proximity sensor 12 which responds to whether the trainee, in performing mouth-to-mouth artificial respiration, closes the nasal opening or, if artificial respiration is being effected through the nasal opening, whether the trainee is appropriately active. Disposed in the neck simulation 4 is a sensor 42 which is responsive to whether the trachea simulation 41 is or is not open for artificial respiration. If for example the head simulation 1 is not correctly inclined rearwardly then, depending on the respective kind of structure which is provided for that purpose, the trachea simulation 41 either remains bent or clamped between clamping elements and is thus not passable for artificial respiration. In that case, the sensor 42 can respond to an air pressure which rises excessively when artificial respiration is carried out, upstream of the bend location or the clamped location. It is however also possible for the sensor to be in the form of a position sensor which senses the pivotal position of the head simulation 1 in the region of the neck simulation 4.

In addition, arranged in the neck simulation 4 is a sensor 43 which in the illustrated embodiment effectively detects the position of the head simulation 1 and which for example can be a limit switch which, upon pivotal movement of the head simulation 1, signals when the correct limit position thereof is reached.

Provided in the proximity of the shoulder of the arm simulation 3 is a motion detector 31 which, similarly to the sensor 43, can responds to actuations, in this case in respect of the arm simulation 3. Associated with the lungs simulation 5 is a sensor 51 which at the same time can be in the form of a measuring device for determining the volume of air which is blown into the lungs simulation 5. That sensor is responsive for example

to the pressure applied thereto by the lungs simulation 5; it is also possible to ascertain the lift of the upper chest wall of the dummy in the artificial respiration procedure as a measurement parameter for determining the volume of air accommodated.

Figure 2 shows the arrangement of a plurality of pressure or push sensors 61 which are arranged in a circle and which establish a "correct" region of the thorax simulation 6, within which the application of compression effects is to be considered as correct. Bearing with the hands outside of or too far outside the region defined by the sensors 61 is to be considered as being an error and gives rise to feedback messages by way of the sensors 61 (see in that respect DE 36 38 192 A1). Arranged in the centre of the region defined by the sensors 61 is a detector 62 for measuring and monitoring the depth of compression of the thorax simulation 6.

Disposed in the region of the inguinal bend of the torso 2 is at least one further sensor 21 which is provided for detecting the posture of the entire body simulation, for example the posture of the legs (not shown in the illustrated embodiment). A sensor suitable for that purpose is one of the same kind which is used as the sensor 43 in the neck simulation 4.

Provided beneath the lungs simulation 5 in the region of the abdomen is a pressure sensor 22 which is capable of detecting variations in pressure in the stomach and abdomen region, which are caused for example by defective compressions of the thorax simulation 6.

All the above-described sensors and measuring devices are connected by way of suitable lines to a computer unit (CPU) 10 and supply thereto signals which are processed therein. The CPU includes memories for storing data which in turn are called up by the CPU upon actuation by a suitable signal from one or more sensors and which are reproduced by a loudspeaker unit 20 in the form of an error message, a correction instruction or a noise utterance from the patient, under the control of the CPU. Figure 2 shows in dash-dotted line a connection between the loudspeaker unit 20 and a headset 20', which is such that instructions and noise utterances can be

outputted either by the loudspeaker unit 20 and the headset 20' simultaneously or in such a way that they can be switched over, separately from each other. In addition, shown in dash-dotted line is a connection between the CPU 10 and an external loudspeaker 20" which can be provided as an alternative for the above-described situation where only noise utterances of the dummy are reproduced by way of the loudspeaker 20 and/or the headset 20' while speech error and correction instructions from an instructor are to be heard only by way of the external loudspeaker 20".

Error and correction messages are caused to occur by the sensors 12, 42, 43, 51 and 61. In the event of defective actuation for example the sensor 12 causes a speech indication to the effect that the nasal opening must be closed when carrying out mouth-to-mouth artificial respiration. Response on the part of the sensor 42 causes a speech message through the loudspeaker 20 that the trachea simulation 41 is blocked and a check has to be made as to whether there is an obstruction in the trachea simulation or whether the head simulation 1 is not sufficiently tilted rearwardly. The latter aspect is also detected by the sensor 43 in the form of a demand for the head simulation 1 to be pivoted correctly rearwardly.

The sensor 51 which at the same time is in the form of a lift detector for detecting lift movement of the lungs simulation 5 produces a message that - if correct - too much air has been blown into the lungs simulation 5 in the artificial respiration procedure. Finally the sensors 61 respond to defective positioning of the hands when carrying out compression and cause a suitable speech error notification, possibly linked with the demand for the hands to be moved further into the "correct" region which is defined by the sensors 21. There is a wide range of different options in regard to the nature of the error messages and correction demands possibly related thereto; by way of example attention is directed in this respect to US No 43 60 345.

Besides the above-described error and correction messages which are caused by response on the part of the sensors and which are outputted by the loudspeaker 20, the signals from the same sensors can also be coupled

in the CPU 10 to data which give patient noise utterances which are produced by the loudspeaker 20. Thus for example a response on the part of the sensor 43 can cause a grunting or pain noise from the patient, from which the trainee can see that the patient is still alive and the head simulation 1 has possibly been pivoted too abruptly, too far or too forcibly. The sensor 51 can cause belching or choking noise utterances to occur, if in performing artificial respiration air is blown into the dummy excessively or too quickly, so that as a result corresponding compression of the stomach occurs in the case of a real patient. Subsequently to artificial respiration not being correctly carried out in that respect, grunting or coughing can also be produced as a noise utterance by the sensor 51 and/or the sensor 42. Response on the part of the sensors 61, even in the case of correct compression, can also give rise to noise utterances in the form of groan or a similar noise, which are to be attributed to compression of the chest region.

Besides the above-described coupling of error and correction messages with noise utterances which are caused by sensors which monitor measures which are crucial in terms of implementing CPR, it is also possible to provide sensors which exclusively cause the output of noise utterances from the patient but which are of lesser significance in terms of correct performance of the CPR procedure. They include for example the sensors 21 and 31 and with limitations also the sensor 22. The sensors 21 and 31 can cause a pain noise or attempts at speech on the part of the patient when the arm 3 or the legs are moved in order realistically to show that the patient is conscious and possibly injured. A similar consideration applies to the function of the sensor 22 which however in addition, in the event of excessive inflation of the lungs simulation 5 or in the event of excessive compression of the thorax simulation 6, indicates an excessive pressure in the thorax simulation 6, which can cause displacement of air or gas in the intestines of the patient. The sensor 22 can therefore produce a noise utterance in the form of a stomach gurgling sound.

The voice with which the error or correction instructions stored in the CPU 10 are produced by the loudspeaker 20 when appropriately operated is desirably not the same as the voice which is associated with the noise utterances from the patient, although in principle that is a possibility. It will be appreciated however that noise utterances in the case of a dummy which is the simulation of a female body are female in nature and similar in regard to a male dummy. Furthermore, a sequence in which error and correction messages are successively produced if a plurality of defective handling operations are carried out at the same time can also be programmed in the CPU 10. This for example may involve artificial respiration being carried into effect too vigorously but at the same time the sensor 12 is responding because the nasal opening is no longer being held sufficiently closed. In this case for example a first indication would be given that the nasal opening must be sealingly closed and it is only thereafter that the question of blowing excessively into the lungs simulation 5 would be raised. A sequence can also be prescribed in regard to the succession of error and correction messages as well as noise utterances, such sequence being desirable in order not to cause sound distortion effects or the like due to simultaneous reproduction. In that respect however, for reasons of realism, it seems desirable firstly to reproduce a nose utterance on the part of the patient, to which the trainee learns to react.

The nature of the electronic circuits which are required by means of the CPU 10 for producing speech error and correction instructions and noise utterances from the patient does not need to be particularly described at this point because such circuits are sufficiently familiar to the man skilled in the electronics art and can be readily designed to carry out the above-described functions.

It is possible to depart from the embodiment described hereinbefore by way of example, without thereby departing from the invention. Thus it is possible and also desirable for the CPU 10 to be so programmed that it does not directly access, in dependence on signals from the sensors, data which by way of the loudspeaker 20 produce a corresponding error and/or

correction message. On the contrary, the sensor signals can first be processed in the CPU 10, in accordance with the number of signal pulses or the number of incorrect pulse heights, and produce a corresponding message only when an excessive frequency is attained. That applies for example in regard to the succession of artificial respiration or compression thrusts. Similarly the time intervals between the artificial respiration and compression thrusts can be measured so that error messages and possibly correction instructions are produced if the time intervals are excessively short or excessively long or if a minimum number of such treatment thrusts is not performed.

CLAIMS

1. A dummy for practising cardiopulmonary resuscitation (CPR) of a human being comprising a simulation (6) of the thorax and the head (1), which dummy includes sensors and an apparatus (10, 20) signal-controlled thereby for producing speech error and/or correction messages, characterised in that the apparatus (10, 20) which is signal-controlled by the sensors is disposed in the dummy itself.

2. A dummy according to claim 1 characterised in that the signal-controlled apparatus (10, 20) includes at least a first and a second memory, wherein error and/or correction messages are stored in the first memory and noise utterances of a patient simulated by the dummy are stored in the second memory.

3. A dummy according to claim 2 characterised in that the noise utterances of the patient are such which are to be expected as the reaction to CPR-actions which remain within the limits of correctness.

4. A dummy according to claim 2 or claim 3 characterised in that the noise utterances of the patient are such which are to be expected in the case of an erroneously effected CPR-action.

5. A dummy according to claim 4 characterised in that the noise utterances of the patient are such which directly permit a conclusion to be drawn in regard to the nature of the erroneous CPR-action and which do not require a speech error and/or correction message.

6. A dummy according to claim 5 characterised in that the apparatus (10, 20) is controlled in such a way that a speech error and/or correction message occurs only after a delay and/or after the expiry of a

predetermined period of time in which no corrected CPR-action was carried out and/or upon repetition of the erroneous CPR-action.

7. A dummy according to one of claims 1 to 6 characterised in that a sound source (20) for reproducing the noise utterance is disposed at a location of the dummy which corresponds to the nature of the noise utterance.

8. A dummy according to claim 7 characterised in that a sound source for the reproduction of noise utterances such as groans, gurgling, coughing and the like is disposed in the head simulation (1).

9. A dummy according to claim 7 or claim 8 characterised in that a sound source (20) for reproducing noise utterances such as vomiting or movements of gas or air in the body is disposed in the thorax simulation (6) or in an abdomen simulation.

10. A dummy according to one of claims 4 to 9 characterised in that the sensors or the signal-controlled apparatus respond to erroneous CPR-actions in the form of an excessive intensity of the CPR-actions to be carried out.

11. A dummy according to claim 10 characterised in that the sensors (51, 22, 62) or the signal-controlled apparatus respond to excessive compression in heart massage and/or excessively high blowing-in pressure when carrying out artificial respiration.

12. A dummy according to one of claims 4 to 11 characterised in that the sensors or the signal-controlled apparatus respond to erroneous CPR-actions in the form of incorrect time intervals between CPR-actions which are to be repeatedly carried out.

13. A dummy according to claim 12 characterised in that the sensors or the signal-controlled apparatus respond to artificial respiration or compression thrusts which are carried out too slowly or too quickly.

14. A dummy according to one of claims 1 to 3 characterised in that the signal-controlled apparatus establishes a sequence for the reproduction of error and/or correction messages upon the simultaneous occurrence of CPR-actions which are erroneous in a plurality of respects.

15. A dummy according to claim 14 characterised in that the signal-controlled apparatus establishes simultaneous reproduction of an error message and a corresponding noise utterance from the patient.

16. A dummy according to claim 14 characterised in that the signal-controlled apparatus establishes a noise utterance from the patient and an error message in immediate succession.

17. A dummy according to one of claims 1 to 16 characterised in that the signal-controlled apparatus includes a CPU (10) and at least one loudspeaker (20).

18. A dummy according to claim 17 characterised in that the loudspeaker is disposed in the dummy and/or in a headset (20').

19. A dummy according to claim 18 characterised in that the function of the loudspeaker (20) in the dummy can be switched over to the function of the headset loudspeaker (20').

20. A dummy according to claim 17 characterised in that there is provided at least one loudspeaker (20") for error and/or correction

messages and a further loudspeaker (20) for noise utterances from a patient simulated by the dummy.

21. A dummy according to claim 20 characterised in that the loudspeaker (20") for error and/or correction messages is arranged outside the dummy.

22. A dummy according to claim 20 characterised in that a loudspeaker for error and/or correction messages is disposed in the dummy and/or in a headset (20') and a third loudspeaker (20") is arranged outside the dummy and that the function of the loudspeaker disposed in the dummy and/or in the headset can be switched over to the function of the external loudspeaker (20").

INTERNATIONAL SEARCH REPORT

In .ational Application No
PCT/DE 99/00608

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G09B23/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G09B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 828 501 A (INGENITO MICHAEL ET AL) 9 May 1989 (1989-05-09) the whole document	1-3, 15-17,20
A		10-13,21
Y	US 5 509 810 A (SCHERTZ MITCHELL ET AL) 23 April 1996 (1996-04-23) column 7, line 16 - column 9, line 19 column 10, line 11 - column 11, line 22	1-3, 15-17,20
A	column 15, line 1 - column 15, line 18; claims 1-3,8-12,16-20,36,45-48; figures 5-7.14A-14D,23A-23B	4,5,7-9, 21
A	US 5 584 701 A (CAROVANO RONALD G ET AL) 17 December 1996 (1996-12-17) column 25, line 44 - column 27, line 48; figures 1,9	1,7,9, 17,18

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
12 July 1999	02/08/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gorun, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/DE 99/00608

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